Appendix A: Additional tables

Table A.1. Observed transitions and line parameters derived from Gaussian fits. Rest frequencies and spectroscopic data are taken from the MADEX catalogue (Cernicharo 2012).

Transition	Frequency (MHz)	E_{up} (K)	A_{ul} (s^{-1})	$\int T_A^* dv$ (mK km s^{-1})	V_{LSR} (km s^{-1})	Δv (km s^{-1})	T_A^* (mK)
NCO ($^2\Pi_{3/2}$)							
$J = 7/2 - 5/2$ $F = 9/2 - 7/2$ e	81404.300	6.6	9.19 10^{-7}	3.6(9)	5.32(4)	0.42(10)	8.0
$J = 7/2 - 5/2$ $F = 9/2 - 7/2$ f	81404.813	6.6	9.19 10^{-7}	4.1(9)	5.41(3)	0.42(7)	9.0
$J = 7/2 - 5/2$ $F = 7/2 - 5/2$ e	81413.120	6.6	8.44 10^{-7}	2.1(9)	5.45(4)	0.34(10)	5.9
$J = 7/2 - 5/2$ $F = 7/2 - 5/2$ f	81413.573	6.6	8.44 10^{-7}	3.2(9)	5.26(4)	0.45(10)	6.6
$J = 7/2 - 5/2$ $F = 5/2 - 3/2$ e	81418.385	6.6	8.17 10^{-7}	2.9(9)	5.24(6)	0.44(11)	6.2
$J = 7/2 - 5/2$ $F = 5/2 - 3/2$ f	81418.884	6.6	8.17 10^{-7}	1.6(9)	5.43(5)	0.27(17)	5.4
$J = 9/2 - 7/2$ $F = 11/2 - 9/2$ e	104665.278	11.7	2.19 10^{-6}	5.0(9)	5.45(5)	0.55(10)	8.6
$J = 9/2 - 7/2$ $F = 11/2 - 9/2$ f	104666.098	11.7	2.19 10^{-6}	5.4(9)	5.43(4)	0.55(7)	9.1
$J = 9/2 - 7/2$ $F = 9/2 - 7/2$ e	104670.139	11.7	2.08 10^{-6}	3.6(9)	5.36(4)	0.45(11)	7.6
$J = 9/2 - 7/2$ $F = 9/2 - 7/2$ f	104670.905	11.7	2.08 10^{-6}	3.9(9)	5.35(3)	0.37(8)	9.9
$J = 9/2 - 7/2$ $F = 7/2 - 5/2$ e	104673.371	11.7	2.05 10^{-6}	1.6(9)	5.26(4)	0.22(7)	7.1
$J = 9/2 - 7/2$ $F = 7/2 - 5/2$ f	104674.173	11.7	2.05 10^{-6}	2.9(9)	5.32(4)	0.35(8)	7.8
H_2NCO^+							
$4_{1,4} - 3_{1,3}$	80246.376	8.7	4.28 10^{-5}	2.0(5)	5.02(1)	0.18(60)	10.4
$4_{0,4} - 3_{0,3}$	80906.926	9.7	4.67 10^{-5}	2.8(5)	5.32(5)	0.53(9)	4.9
$4_{1,3} - 3_{1,2}$	81565.636	8.8	4.49 10^{-5}	4.9(9)	5.16(5)	0.63(10)	7.3
$5_{1,5} - 4_{1,4}$	100306.949	13.5	8.74 10^{-5}	5.0(5)	5.37(3)	0.53(5)	8.9
$5_{0,5} - 4_{0,4}$	101131.130	14.6	9.33 10^{-5}	3.8(9)	5.45(7)	0.70(15)	5.0
$5_{1,4} - 4_{1,3}$	101955.974	13.7	9.18 10^{-5}	4.2(9)	5.20(4)	0.38(8)	10.4
$HNCOH^+$							
5 − 4	99559.525	14.3	8.82 10^{-6}	<0.8			<3.3
HNCO							
$4_{0,4} - 3_{0,3}$ $F = 3 - 3$	87924.381	10.5	7.25 10^{-7}	19(1)	5.33(1)	0.33(2)	53.5
$4_{0,4} - 3_{0,3}$ $F = 5 - 4$	87925.252	10.5	9.02 10^{-6}	761(2)	5.31(1)	0.44(1)	1619.6
$4_{0,4} - 3_{0,3}$ $F = 4 - 3$	87925.252	10.5	8.46 10^{-6}				
$4_{0,4} - 3_{0,3}$ $F = 3 - 2$	87925.252	10.5	8.29 10^{-6}				
$4_{0,4} - 3_{0,3}$ $F = 4 - 4$	87925.898	10.5	5.64 10^{-7}	24(1)	5.30(1)	0.40(2)	57.4
$5_{0,5} - 4_{0,4}$ $F = 4 - 4$	109904.922	15.8	8.81 10^{-7}	12(1)	5.33(1)	0.34(3)	33.2
$5_{0,5} - 4_{0,4}$ $F = 6 - 5$	109905.758	15.8	1.80 10^{-5}	553(1)	5.31(1)	0.36(1)	1450.3
$5_{0,5} - 4_{0,4}$ $F = 5 - 4$	109905.758	15.8	1.73 10^{-5}				
$5_{0,5} - 4_{0,4}$ $F = 4 - 3$	109905.758	15.8	1.71 10^{-5}				
$5_{0,5} - 4_{0,4}$ $F = 5 - 5$	109906.430	15.8	7.21 10^{-7}	11(1)	5.31(2)	0.37(4)	28.2
HOCN							
$4_{0,4} - 3_{0,3}$	83900.569	10.1	4.18 10^{-5}	50(1)	5.31(1)	0.47(1)	99.7
$5_{0,5} - 4_{0,4}$	104874.676	15.1	8.36 10^{-5}	34(1)	5.30(1)	0.38(1)	83.2
HCNO							
4 − 3	91751.320	11.0	3.84 10^{-5}	21(1)	5.33(1)	0.41(2)	47.4
5 − 4	114688.383	16.5	7.67 10^{-5}	8(2)	5.35(3)	0.26(5)	28.6
HONC							
4 − 3	87625.193	10.5	3.41 10^{-5}	<2.1			<8.1
5 − 4	109530.044	15.8	6.81 10^{-5}	<1.6			<6.9

Table A.2. Formation enthalpy estimates in kcal mol^{-1}

Species	ΔH	Ref.
$HNCO^+$	243	1
$HOCN^+$	274	2
$HCNO^+$	292	2
$HONC^+$	331.7	2
$HNOC^+$	331.4	2
H_2NCO^+	167	1
$HNCOH^+$	183	3
$HCNOH^+$	234.8	3
H_2OCN^+	240.9	3
H_2CNO^+	243	3

Notes. (1) Lias et al. (1984); (2) computed from Luna et al. (1996) using the experimental value for the most stable isomer $HNCO^+$; (3) computed from Ijjaali et al. (2001) using the experimental value for the most stable isomer H_2NCO^+.

Table A.3. Assumed rate coefficients of the DR reaction of the CH_2NO^+ ions.

Reaction	Rate Coefficient ($\times 10^{-7}$(T/300)$^{-0.5}$ cm^3 s^{-1})
H_2NCO^+ + e → HNCO + H	2.50
H_2NCO^+ + e → CO + NH_2	0.50
H_2NCO^+ + e → NCO + H_2	1.50
H_2CNO^+ + e → HCNO + H	2.50
H_2CNO^+ + e → CH_2 + NO	0.50
$HCNOH^+$ + e → HCNO + H	2.50
$HCNOH^+$ + e → HONC + H	0.50
$HCNOH^+$ + e → HCN + OH	0.50
$HNCOH^+$ + e → HOCN + H	0.50
$HNCOH^+$ + e → HNCO + H	2.50
$HNCOH^+$ + e → HNC + OH	0.50
H_2OCN^+ + e → HOCN + H	1.50
H_2OCN^+ + e → H_2O + CN	0.50